2008 GOES-R
Algorithm Working Group
Annual Meeting Poster Session

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Room 313, Pyle Center, UW-Madison

1. *New Automated Methods for Detecting Volcanic Ash and Determining Mass Loading from Infrared Radiances: Looking Towards the GOES-R Era*

Presenter: Michael Pavolonis, NOAA/NESDIS/StAR/ASPB
Authors: Michael Pavolonis and Justin Sieglaff

The next generation GOES Imagers, the Advance Baseline Imager (ABI) will offer increased spectral coverage of the infrared portion of the electromagnetic spectrum (9 IR bands on ABI to 4 IR bands on current GOES Imagers). Most significant for volcanic ash and other aerosol detection is the addition of an 8.5 µm channel, along with 11 and 12 µm channels. Traditionally volcanic ash and other aerosols are detected using brightness temperature differences (BTD). One large shortcoming of the BTD technique is the lack of surface, atmospheric absorption, and viewing angle corrections. The GOES-R AWG Aviation group is utilizing a derived radiative parameter, β, which is directly related to particle size, habit, and composition. We present a robust method for automatically detecting volcanic ash and estimating the height and mass loading utilizing the β parameter. The β parameter allows for a maximization of the information content of the measurements by accounting for the background clear sky contribution in the measured radiance, isolating the cloud microphysical signal contained in the measurements. We show through use of SEVIRI data as a proxy for ABI data that this method allows for improved volcanic ash detection and property retrievals.

2. *A Flight Icing Threat Algorithm for GOES-R*

Presenter: William Smith, NASA -Langley
Authors: William L. Smith Jr., Stephanie Houser, Patrick Minnis and Doug Spangenberg

Aircraft icing is one of the most dangerous weather conditions for general aviation. Currently, model forecasts and pilot reports (PIREPS) constitute much of the database available to pilots for assessing the icing conditions in a particular area. Such data are often uncertain or sparsely available. A novel method for determining flight icing conditions from satellite data has been developed for application to current GOES satellites. The algorithm is physically based, relying on the determination of satellite-derived cloud parameters and thus also applicable to MODIS and SEVIRI data. This poster reports progress and refinements to the algorithm for GOES-R. The refinements are based on correlations between PIREPS icing reports and satellite-derived cloud liquid water path and effective radius for super-cooled liquid water clouds that occurred over the continental U.S and Canada during the 2006/2007 and 2007/2008 winters. This effort will provide improvements in the temporal and areal coverage of icing diagnoses and prognoses and will mark a substantial enhancement in aviation safety in regions susceptible to heavy super-cooled liquid water clouds.

3. *SEVIRI and GOES-R ABI infrared radiances: preliminary results*

Presenter: Leonid Roytman, NOAA_CREST, City College, New York
Authors: Atiqur Rahman, Leonid Roytman, Felix Kogan and Mitch Goldberg

GOES-R ABI will be the first GOES imaging instrument providing observations in both the visible and the near infrared spectral bands. Meteosat Second Generation, Meteosat-8 satellite with its Spinning Enhanced Visible and Infrared Imager (SEVIRI) data for are now available to Earth System Scientists. SEVIRI sensor detects radiation in 12 spectral bands among which two are specifically suited for vegetation studies. MSG data have the great advantage over data from the polar orbiting satellites that the frequency of observations is so much higher (30 min interval versus one hour interval daily acquisitions), thus the chances to avoid cloud cover are much improved, which open up for a new vegetation monitoring scheme. In this study, the use of MSG SEVIRI data for assessment of vegetation cover is explored for the African continent based on data from February to December, 2007.This poster presents the results of the work on generating NDVI and evaluating compositing algorithms using Meteosat 8/9 SEVIRI data as a proxy for GOES-R ABI prototype.

4. *GOES-R Baseline Instruments*

Presenter: Timothy J. Schmit, NOAA/NESDIS/StAR/ASPB
Authors: James J. Gurka, Timothy J. Schmit, Steven Goodman, Steven Hill, Mathew M Gunshor

In order to meet the requirements, documented by the Geostationary Operational Environmental Satellite (GOES) user communities, the instruments on the GOES-R include an Advanced Baseline Imager (ABI), a Geostationary Lightning Mapper (GLM), and advanced space and solar observing instruments including the Solar UV Imager (SUVI), Extreme UV/ X-Ray Irradiance Sensor (EXIS), a Magnetometer, and the Space Environment In-Situ Suite (SEISS). The GOES-R instruments will monitor a wide range of phenomena, including applications relating to: weather, climate, ocean, land, cryosphere, hydrology, hazards, solar and space.

The Advanced Baseline Imager (ABI) is a state of the art, 16-band imager covering 6 visible (VIS) to near-infrared (NIR) bands (0.47 um to 2.25 um), and 10 infrared (IR) bands (3.9 um to 13.3 um). Spatial resolutions are band dependent, 0.5 km at nadir for broadband VIS, 1.0 km for NIR and 2 km for IR. The ABI will be capable of scanning the Full Disk (FD) in approximately 5 minutes. ABI will improve every product from the current GOES Imager and will introduce a host of new products. Recent estimates of the ABI socio-economic benefits, above that from the current imager, are estimated to be almost $5B.

The new GOES-R Geostationary Lightning Mapper (GLM) is a single channel, near-IR transient detector that will continuously measure total lightning activity with near-uniform spatial resolution of 8-12 km over the full-disk. The GLM will detect total lightning flash rate and changes in flash rate over both land and water. Total lightning activity is related to the updraft strength and the amount of ice in the mixed phase region of thunderstorms. By monitoring lightning frequency, one can infer storm kinematics and microphysical structure and, therefore, changes in storm severity.

The solar instruments and the Space Environment In-Situ Suite (SEISS), to monitor the highly variable solar and near-Earth space environment continue a long history of space weather observations from the GOES program. These observations are used to protect life and property of those sensitive to solar and space weather fluctuations. The expanded services from GOES-R will improve support to forecasters at NOAA’s Space Weather Prediction Center (SWPC); customers in other government agencies, such as DOD (Department of Defense) and NASA (National Aeronautics and Space Administration); commercial users of space weather services; and international space environment services.

Additional capabilities include improved user services, such as GOES-R ReBroadcast (GRB), Search and Rescue (SAR), Data Collection System (DCS), Emergency Managers Weather Information Network (EMWIN) and Low Rate Information Transmission (LRIT). More information on GOES-R can be found on the joint NOAA/NASA GOES-R Program Office website: http://www.goes-r.gov/.

5. *GOES-R trade studies*

Presenter: Jun Li, CIMSS/SSEC/UW-Madison
Authors: Jun Li, Timothy J. Schmit, James J. Gurka, Jinlong Li and Chian-Yi Liu

The objectives of the GOES-R (and beyond) instrument and requirement studies at CIMSS/SSEC/UW-Madison are (1) to conduct research on future GOES advanced infrared sounding requirements and definition, to perform trade-off studies to balance the spectral coverage/resolution, spatial resolution, temporal resolution, radiometric resolution, ensquared energy, etc. for hyperspectral IR instrument optimization; (2) to help evaluate user requirements, and transform these requirements for data, product, and service into GOES-R (and beyond) applicable technical requirements; and (3) to study the advantages and benefits from the GOES-R (and beyond) system over the current GOES system in forecasting and nowcasting significant weather and environmental events. This project is an enhancement and a compliment to the GOES-RRR and GOES-R AWG programs.

6. *GOES-R Proving Ground Concept*

Presenter: James Gurka, NOAA/NESDIS/GOES-R
Authors: Jim Gurka, Tim Schmit, Tony Mostek

A proving ground is a place where technologies and ideas are tested and proven before they are finalized and incorporated into field operations. The key mission of the Satellite Proving Ground is to demonstrate new satellite observing data, products and capabilities in operational NOAA Offices. This key activity will facilitate the transfer of new capabilities into NOAA operations in a much more efficient manner. This program directly addresses the concerns raised by various studies that identified the major challenges posed when trying to move new products into NOAA’s operational programs, also know as trying to “Cross the Valley of Death”.

This is beyond simply testing a piece of software to see if it works. It focuses on evaluating how the infusion of the technology or procedure integrates with other available tools in the hands of the forecaster responsible for issuing forecasts and warning products. Additionally, the testing concept fosters operation and development staff interactions which will improve training materials and support documentation development.

The proving ground concept allows forecasters to be involved at the conceptual level, provides the opportunity for interaction between developers and users, and is the ultimate tool to ensure user readiness. The foundation for the GOES-R Proving ground is the funding of extra personnel, including satellite applications experts, computer and technical support , at NOAA cooperative institutes to work directly with NWS forecast offices or National Centers.

In FY08, proving grounds were established through the Cooperative Institute of Meteorological Satellite Studies (CIMSS) in Madison Wisconsin, and the Cooperative Institute for Research in the Atmosphere (CIRA) in Fort Collins, Colorado. In subsequent years, the Proving Ground will be expanded to include at least one additional Cooperative Institute. The Proving Ground will include two levels of interaction, local and distributed. For the local level CIMSS and CIRA will build on close relationships established with the NWS Forecast Offices at Milwaukee/ Sullivan WI, LaCrosse WI and Cheyenne WY, Boulder CO,. The distributed level of interaction will include the following NCEP centers: Tropical Prediction Center, Ocean Prediction Center, Hydrometeorological Prediction Center, Storm Prediction Center, and the Aviation Weather Center and other selected NWS Forecast Offices.

In the Proving Grounds, developers and forecasters will test and apply algorithms for new GOES-R satellite data and products, using proxy and simulated data sets, including MODIS, AIRS, IASI, SEVIRI, NAST-I, NPP/VIIRS/CrIS, and computer simulated products. They will test and validate data processing and distribution systems as well as the applications of these products in an operational setting. Additionally developers and forecasters will test and apply display techniques and decision aid tools in an operational setting. In order to better familiarize forecasters with the data from GOES-R, a weather event simulator will also be developed. It is expected that the proving ground will lead to a two-way interaction where researchers introduce new products to forecasters and forecasters providing feedback and ideas for improved or new products.

7. *The Synertistic Use of GEO Imager and LEO Sounder Measurements for Atmospheric Profiling*

Author: Chian-Yi Liu, CIMSS/SSEC/UW-Madison

Hyperspectral infrared (IR) sounder from low earth orbit (LEO) provides temperature and moisture soundings with high accuracy and high vertical resolution, however, due to it low temporal coverage rate (twice every day for one sounder instrument), data are usually missing during short range convective storm development. The Advanced Baseline Imager (ABI) onboard the next generation of geostationary (GEO) satellite, on the other hand, provides very fast coverage rate but lower vertical resolution and less accurate profiles. Combination of GEO ABI measurements and LEO hyperspectral IR sounder data may provide atmospheric evolution with high temporal resolution and fairly vertical structure. An algorithm is developed for monitoring the sounding evolution from combined GEO imager and LEO IR sounder data. The collocated geolocation of and GEO imager and LEO sounder systems can (1) provide LEO sounder sub-pixel cloud characterization (mask, amount, phase, layer information, etc.) within the large sounder footprint; (2) be used for LEO sounder cloud-clearing for partly cloudy footprints; (3) provide background information in variational retrieval of cloud properties with sounder cloudy radiances; (4) provide real-time background information for GEO imager instantly without Numerical Weather Prediction (NWP) forecast. The Moderate-Resolution Imaging Spectroradiometer (MODIS) and the Atmospheric Infrared Sounder (AIRS) measurements from the Earth Observing System's (EOS) Aqua satellite provide the opportunity to study the synergistic use of advanced imager and sounder measurements. The combined MODIS and AIRS data for various scenes are analyzed to study the utility of synergistic use of ABI products and LEO sounder radiances for better retrieving atmospheric soundings and cloud properties.

8. *Mesoscale Resolution Retrievals Obtained from the Combination of GOES-R ABI and Polar Satellite Hyperspectral Radiances*

Presenter: W.L. Smith, Hampton University/UW-Madison

Authors: W. L. Smith and S. Kireev

An algorithm is developed for the achieving the highest possible temporal and spatial resolution vertical soundings and surface skin temperature through the combination of GOES ABI and polar satellite hyperspectral data. These retrievals are important for achieving the mesoscale weather forecast objectives of the US satellite program. The algorithm will be discussed and examples of its application will be shown using MetOp satellite data observed at the ARM cart-site and over the Gulf of Mexico during the Joint Airborne IASI Validation Experiment (JAIVEx).

9. *CIMSS GOES-R Proving Ground Plans*

Presenter: Justin Sieglaff, CIMSS/SSEC/UW-Madison

Authors: Justin Sieglaff, Kaba Bah, Tim Schmit, Jordan Gerth, Scott Bachmeier, Steve Ackerman, Wayne Feltz, Kathy Strabala, Gary Wade, Jason Otkin

The primary function of the GOES-R Proving Ground project is to prepare National Weather Service (NWS) forecasters for use of GOES-R Advanced Baseline Imager (ABI) data and products prior to launch. Forecaster training before launch is necessary so all ABI spectral bands and derived products can be utilized by forecasters immediately after ABI enters operational scan mode after launch in 2016. At CIMSS, we have proposed to leverage existing advanced instruments (such as MODIS, AIRS, and IASI) and simulated GOES-R AWG Proxy data to demonstrate the abilities of ABI. Currently, various MODIS spectral bands, derived MODIS products and MODIS true color imagery are being delivered to 16 NWS Weather Service Forecast Offices (WSFOs) in near-real time via AWIPS (Advanced Weather Interactive Processing System). AIRS and IASI data and products will be added to this data stream in the near future. In addition, experimental products using current GOES imagers (such as mesoscale winds) are also being delivered to NWS WSFOs via AWIPS. The GOES-R AWG Proxy Data group at CIMSS has produced a 2km CONUS simulation for a convective outbreak on June 4-5, 2005. The 2km CONUS model data was input to radiative transfer models to generate simulated ABI spectral bands for the convective outbreak. The ABI spectral bands, along with spectral band differences, derived products, NWP grids, radar and other data sets will be added to the NWS Weather Event Simulator (WES). The WES is an identical version of the real-time, operational AWIPS forecasters use but with historical case study datasets for training purposes. The WES framework will allow forecasters to learn about ABI spectral bands and products within a familiar, operational-style environment.

10. *GOES-R ABI Sounding Validation Using AEROSE-Domain SEVIRI Data*

Presenter: Hua Xie, Perot Systems Government Services, Inc.
Authors: Hua Xie, Nicholas Nalli, Christopher Barnet and Mitch Goldberg

To facilitate the development, validation and demonstration of the GOES-R Advanced Baseline Imager (ABI) legacy sounding products, we have built a large, ocean-based, empirical proxy-dataset, based upon actual satellite measurements taken over the tropical Atlantic, as opposed to radiative transfer model simulations. Our proxy dataset is unique in that the satellite measurements will be supplemented by ship-based measurements acquired at sea during several trans-Atlantic Aerosol and Ocean Science Expeditions (AEROSE) (Morris et al., 2006). The AEROSE campaigns include the most comprehensive collection of in situ measurements of the Saharan air layer (SAL) and associated dust outflows over the tropical Atlantic. The AEROSE shipboard data complement includes Vaisala rawinsonde observations (RAOBs) (Nalli et al., 2005), ozonesondes, calibrated IR spectra and high accuracy sea surface skin temperature (skin SST) from Marine Atmospheric Emitted Radiance Interferometers (M-AERI) (Minnett et al., 2001), Microtops sunphotometers, micropulse lidar (MPL) and ceilometer. We have collected Spinning Enhanced Visible and Infrared Imager (SEVIRI) satellite data within the AEROSE space-time domains [10S, 35N; 80W, 10W], rather than merely at the ship locations/times, so that dynamical features over the tropical Atlantic (e.g., SAL, dust outflows, tropical convection, etc.) can be observed and studied. In this preliminary work, we present some initial SEVIRI retrieval validation results based upon radiosonde matchup locations obtained during the AEROSE campaigns. The multi-year AEROSE datasets will be useful for studying the impact of GOES-R for observing these and other interesting mesoscale and synoptic scale phenomena over the Atlantic Ocean.

11. *Preliminary Validation of Simulated Proxy Data Cloud Fields using GOES-12 Imager Data*

Author: Tom Greenwald, CIMSS/SSEC/UW-Madison

Producing high quality proxy data sets for GOES-R ABI-related research are important in developing and testing new products and algorithms. This study evaluates a high-resolution (6 km) WRF model simulation of top-of-atmosphere radiances using GOES-12 Imager data to determine whether the simulated cloud fields contain sufficient realism for cloud-related studies. A retrospective WRF model forecast was conducted for 4 June 2005 that spanned nearly the entire region covered by the GOES-12 imager in full-disk mode. The CIMSS forward radiative transfer model system, which includes parts of the CRTM, was used to simulate three of the GOES-12 imager's bands: 0.64 microns, 3.9 microns, and 10.8 microns that correspond approximately to ABI bands 2, 7, and 14, respectively.

Results indicate that, overall, the WRF-simulated cloud fields captured a wide range of cloud types as seen from observations, although there were deficiencies. Notably, the simulated visible reflectances tended to be larger on average than the observations and the simulated 3.9 micron reflectances, which were larger for lower-level clouds than observed, suggests the WRF model produced lower-level clouds with smaller effective radii than observed.

12.A. *Using satellite observations to validate a large-scale high-resolution proxy dataset*

Presenter: Justin Sieglaff, CIMSS/SSEC/UW-Madison
Authors: Jason Otkin, Tom Greenwald, Justin Sieglaff, Erik Olson, and Allen Huang

The Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin-Madison is heavily involved in GOES-R satellite algorithm development, risk reduction, data processing, and measurement capability demonstration activities. In support of this work, an end-to-end processing system that utilizes proxy top of atmosphere radiance datasets derived from numerical model output has been developed. The first step in the end-to-end system is to use the Weather Research and Forecasting (WRF) model to perform a high-resolution simulation covering a large geographic domain. Model-simulated temperature, moisture, and cloud data are subsequently combined with climatological information (such as ozone) to generate simulated atmospheric profile datasets, which are then used by the forward radiative transfer model to produce proxy GOES-R radiances.

In this paper, we will describe our recent simulation activities, which includes two high-resolution, large-scale model simulations that were performed at the National Center for Supercomputing Applications during 2007. The first simulation contained 3 nested domains configured to represent the anticipated GOES-R scanning regions (i.e. full disk, CONUS, and mesoscale). The second simulation covered most of the Meteosat viewing area with 3-km horizontal resolution. Proxy radiance datasets generated from these massive simulations provide an important opportunity to realistically demonstrate GOES-R measurement capabilities.

12.B. ***Large-scale model-derived proxy datasets used for GOES-R research activities***

Presenter: Justin Sieglaff, CIMSS/SSEC/UW-Madison
Authors: Jason Otkin, Justin Sieglaff, Tom Greenwald, and Yong-Keun Lee

The Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin-Madison is heavily involved in GOES-R measurement simulation and demonstration activities. As part of this work, a very large-scale, high-resolution WRF model simulation was recently performed on a high-performance supercomputer at the National Center for Supercomputing Applications. The simulation contained a single 5950 x 5420 grid point domain covering most of the Meteosat viewing area (80º W to 80º E; -58º S to 58º N) with 3-km horizontal resolution. Approximately 1.5 TB of memory and 92,000 CPU hours were required to complete the 30-hr simulation.

The availability of this unique dataset provides a valuable opportunity to evaluate the ability of a particular physical parameterization suite to accurately simulate the atmospheric state for a diverse range of cloud types and conditions. Thus far, synthetic SEVIRI infrared brightness temperatures and CloudSat cloud reflectivities have been computed for this case. Preliminary comparisons between the real and simulated observations are very encouraging. For instance, probability distributions constructed for each SEVIRI channel show a remarkable level of agreement with mean brightness temperature biases generally less than 1 K over the entire model domain. Although limited in geographical coverage, CloudSat observations were used to examine the vertical structure of the simulated cloud fields. Overall, the simulation realistically depicted the vertical structure of many cloud types, particularly those associated with mid-latitude disturbances, but performed poorly in other regions, such as those containing shallow marine stratocumulus clouds.

13. ***GOES-R AWG Proxy Data Science and Development***

Presenter: Fuzhong Weng, NOAA/NESDIS/StAR
Authors: Fuzhong Weng et al

Proxy data team continue developments of all the proxy data requested by GOES-R AWG application teams. The high-quality data sets are developed from satellite observations and radiative transfer simulations. Radiative transfer simulations are also updated using newly released instrument spectral and spatial response function. Several new simulation data sets are generated including ABI high-resolution fire and hot spots and global full disk ABI imagery. These valuable proxy data sets will be further refined to support the over-arching requirements in GOES-R algorithm validation.

As part of proxy data team tasks, we also develop and integrate the advanced radiative transfer modeling components into the community radiative transfer model (CRTM). The CRTM is a state-of-the-art software system and can be used to meet the general requirements by the application teams.

14. ***GOES-R ABI Proxy Data Generated from Ultraspectral Sounders***

Presenter: Daniel Zhou, NASA Langley Research Center
Authors: Daniel Zhou and Xu Liu, NASA LARC, Fuzhong Weng and Mitch Goldberg, NOAA/NESDIS

High quality and realistic proxy data which represent a large variety of atmospheric and surface/cloud conditions are critical for the design of a new instrument and its data processing algorithms. NAST I provides high-spatial resolution (2-km) and IASI provides a lower spatial resolution (15-km) but with a global coverage; both instruments have an ultra-spectral resolution with a spectral coverage of 645-2700 cm 1. Because of their spectral resolution and coverage, they are ideal instruments for generating proxy data for new sensor development. NAST-I and IASI are aimed at providing high quality and realistic proxy data in conjunction with associated atmospheric and surface/cloud parameters for the GOES-R Algorithm Working Group for algorithm development. ABI proxy data development with NAST-I and IASI are reported.

15. ***GOES-R ABI Proxy Data Set Generation at CIMSS***

Presenter: Mathew Gunshor, CIMSS/SSEC/UW-Madison
Authors: Mathew Gunshor, Tom Greenwald, Allen Huang, Erik Olson, Jason Otkin, and Justin Sieglaff

The Advanced Baseline Imager (ABI) on GOES-R will represent a technological leap in weather and environmental satellite capabilities. With 16 spectral bands, faster data rates, and improvements in resolution, signal to noise and calibration accuracy over the current imager. Preparing users for what lay ahead is a task being tackled by various research groups. At the Cooperative Institute for Meteorological Satellite Studies (CIMSS) multiple data sets are being generated in an effort to meet the needs of various GOES-R Algorithm Working Group (AWG) science teams. Parallel efforts are underway to provide simulated Advanced Baseline Imager (ABI) data from both existing satellite assets and from the Weather Research Forecast (WRF) model. Simulations from the WRF are being produced at multiple resolutions and time intervals to simulate ABI scanning scenarios such as 15 minute full disk and 5 minute Continental US (CONUS) modes. WRF model simulations are turned into ABI imagery using a forward radiative transfer model that incorporates both clear and cloudy-sky properties and a reflected component for the shortwave and visible bands. Some simulated datasets contain simulated instrument effects such as striping, random noise, and navigation shifts. A sophisticated remapping technique is being used to simulate the ABI from MODerate-resolution Imaging Spectroradiometer (MODIS) data. Most of the ABI spectral bands have similar counter-parts on MODIS and this technique involves remapping the MODIS to a presumed ABI projection, 2 km resolution at nadir (assumed to be at 75 W), and applying a point spread function. This poster will highlight the simulated datasets available so far, show what datasets are planned for the immediate future, and discuss possible avenues of future development into improving techniques.

16. *The UW-CIMSS Advanced Dvorak Technique (ADT) - Looking Towards GOES-R*

Presenter: Tim Olander, CIMSS/SSEC/UW-Madison
Authors: Tim Olander and Chris Velden

The UW-CIMSS Advanced Dvorak Technique is a satellite-based algorithm which estimates tropical cyclone (TC) intensity using geostationary, infrared window channel satellite imagery. The ADT has been used globally by several operational TC forecasting centers for many years and will continue to be used in the future due to the reliance upon proper satellite imagery analysis in TC forecasting and analysis. As satellite technology continues to advance, the ADT will also need to evolve to properly utilize the improved satellite data. This study utilized current available MODIS imagery as a proxy for the expected GOES-R Advanced Baseline Imager 9ABI) data which will be available once the GOES-R ABI becomes operational. The objectives and methodology of the study will be outlined and all results and interpretations will be presented regarding it's impact on the ADT.

17. *GOES-R Aviation Algorithm Working Group - Toward Meeting Aviation Related Requirements*

Presenter: Wayne F. Feltz, CIMSS/SSEC/UW-Madison
Authors: Wayne F. Feltz, Kenneth Pryor, Kristopher Bedka, Dan Lindsey, John Mecikalski, Michael Pavolonis, Bill Smith Jr., and Anthony Wimmers

The GOES-R Aviation Algorithm Working Group was formed in November 2006 to assess meeting aviation related requirements as defined in the GOES-R Mission Requirements Document. A suite of experimental products are in development and are being evaluated to assess meteorological hazards to aircraft in flight derived from the current generation of Geostationary Operational Environmental Satellite (GOES) and European SEVIRI imager data. The specific GOES-R measurement requirements relating to satellite-based aviation hazard derived products are fog, aircraft icing, microbursts, turbulence, SO2, volcanic ash, convective initiation, and enhanced-v/overshooting top detection. The GOES-R Aviation AWG is tasked to adapt the current suite of experimental and operational aviation product algorithms, with modifications and enhancements, for the GOES-R Advanced Baseline Imager (ABI). This presentation will overview the aviation requirements being addressed and progress toward making them GOES-R ready for an anticipated 2014 launch.

18. *GOES-R Geostationary Lightning Mapper Performance Specifications and Algorithms*

Presenter: Douglas M. Mach, University of Alabama in Huntsville
Authors: Douglas M. Mach, Steven J. Goodman, Richard J. Blakeslee, William J. Koshak, Walter A. Petersen, Robert A. Boldi, Lawrence D. Carey, Monte G. Bateman, Dennis E. Buechler, and E. William McCaul Jr

The Geostationary Lightning Mapper (GLM) is a single channel, near-IR imager/optical transient event detector, used to detect, locate and measure total lightning activity over the full-disk as part of the next generation NOAA Geostationary Operational Environmental Satellite (GOES-R) series. The mission objectives for the GLM are to 1) provide continuous, full-disk lightning measurements for storm warning and nowcasting, 2) provide early warning of tornadic activity, and 3) accumulate a long-term database to track decadal changes of lightning.
In parallel with the instrument development, a GOES-R Risk Reduction Team and Algorithm Working Group Lightning Applications Team have begun to develop the Level 2 algorithms and applications. The instrument data will consist of pixels that are nominally optical output from lightning flashes. These “events” will be clustered by the GLM algorithm into “groups” (sets of adjacent illuminated pixels at the same time) and “flashes” (sets of groups within 16.5 km and 330 ms of each other). Proxy total lightning data from the NASA Lightning Imaging Sensor on the Tropical Rainfall Measuring Mission (TRMM) satellite and regional test beds (e.g., Lightning Mapping Arrays in North Alabama and the Washington DC Metropolitan area) are being used to develop and tune the pre-launch algorithms and applications. We will present our current work on algorithm creation, testing, and evaluation, our current work on proxy data creating and validation, and our plans for our further testing and validation.

19. ***Improvements on GOES-R/ABI Legacy Profile Algorithm***

Presenter: Xin Jin, CIMSS/SSEC/UW-Madison

Authors: Xin Jin, Jun Li, Timothy J. Schmit, Jinlong Li, Elisabeth Weisz, Zhenglong Li, and Mitchell D. Goldberg

Numerical products from WRF model are used as proxy to test the algorithm to retrieve the legacy atmospheric profiles from the GOES-R/ABI. The ECMWF 12H global forecasts and NAM 3H regional forecasts are used as first guess. It is found that the regional model is better than global models as first guess. The SEVIRI-radiosonde match-up dataset for August 2006 is also used to test the impacts of different radiative model on physical retrieval. It is found that RTTOV model is better than PFAAST in profile retrievals.

20. ***Microburst Windspeed Potential: Progress and Developments***

Author: Kenneth L. Pryor, NOAA/NESDIS/STAR

A suite of products has been developed and evaluated to assess hazards presented by convective downbursts to aircraft in flight derived from the current generation of Geostationary Operational Environmental Satellite (GOES) (8-P). The existing suite of GOES microburst products employs the GOES sounder to calculate risk based on conceptual models of favorable environmental profiles for convective downburst generation. Large output values of the microburst index algorithms indicate that the ambient thermodynamic structure of the troposphere fits the prototypical environment for each respective microburst type (i.e. Wet, Hybrid, Dry, etc.). Accordingly, a diagnostic nowcasting product, the Microburst Windspeed Potential Index (MWPI), is designed to infer attributes of a favorable microburst environment: large CAPE and a relatively deep convective mixed layer with a steep temperature lapse rate and low relative humidity in the surface layer. These conditions foster intense convective downdrafts due to evaporational cooling of precipitation in the sub-cloud layer and the resultant generation of negative buoyancy.

This paper provides an updated assessment of the MWPI algorithm, presents case studies demonstrating effective operational use of the MWPI product, and presents validation results for the early part of the 2008 convective season. The MWPI algorithm is intended for implementation in the GOES-R Advanced Baseline Imager (ABI) that has promising capability as a sounder with greatly improved temporal and spatial resolution as compared to the existing GOES (8-P) sounders. The increase in temporal resolution should greatly aid the mesoscale forecaster in the analysis of trends in thermodynamic environments. Considering that seven of the sixteen bands of the ABI are in common with the bands of the heritage sounder, the ABI should effectively produce a sounding profile comparable in quality to the current GOES.

21. ***Algorithm and Software Development of Atmospheric Motion Vector Products for the Future GOES-R Advanced Baseline Imager (ABI)***

Presenter: Jaime Daniels, NOAA/NESDIS/STAR

Authors: Jaime Daniels, Chris Velden, Wayne Bresky, Iliana Genkova,, Steve Wanzong, and Howard Berger

Atmospheric motion vectors (AMVs), derived from the current GOES series of satellites, provide invaluable tropospheric wind information to the meteorological community. AMVs obtained from tracking features (i.e., clouds and moisture gradients) are used for: i) Improving numerical weather prediction (NWP) analyses and forecasts; ii) Supporting short term forecasting activities at National Weather Service (NWS) field offices; and iii) Generating tropical and mesoscale wind analyses.

The GOES-R Algorithm Working Group (AWG) Winds application team is working on development of algorithms and software for the generation of Atmospheric Motion Vectors (AMVs) from the GOES-R Advanced Baseline Imager (ABI) to be flown on the next generation of GOES satellites. The GOES-R series of satellites offers exciting new capabilities that are expected to directly benefit and improve the derivation and quality of the AMVs. These new capabilities include: continuous scanning with no loss of imagery due to eclipse or conflicting scanning schedules, higher resolution (spatial and temporal) imagery, and improved navigation. Improved cloud-top height assignments derived from the GOES-R ABI are expected to contribute to further improvement and utilization of the AMV products.

GOES-R AMV software development and testing is being done within a framework that supports a tiered algorithm processing approach that allows the output of lower-level algorithms to be available to subsequent higher-order algorithms while supplying needed data inputs to all algorithms through established data structures. MSG/SEVERI, current GOES imager, and simulated ABI imagery are being used as proxy datasets for GOES-R ABI AMV development, testing, and validation activities. This poster will highlight the AMV algorithms and results from recent testing.

22. ***Application of SEVIRI Multi-spectral Image for Precipitation Estimation***

Presenter: Kuolin Hsu, University of California, Irvine

Authors: Kuolin Hsu, Ali Behrangi, Soroosh Sorooshian, and Robert Kuligowski

The NOAA's future GOES-R satellite is planned to carry the Advanced Baseline Imager (ABI) sensor with 16 VIS/IR bands and improved resolution in time and space. This will create a great milestone toward multi-spectral precipitation estimation. In this study, rainfall rate estimation using multi-spectral channels from the Spinning Enhanced Visible and

Infrared Imager (SEVIRI) instrument of Meteorsat Second Generation (MSG) satellites is explored. As SEVIRI and future GOES-R ABI consist of many common spectral channels, the algorithm developed using SEVIRI image channels can be adjusted and used in the GOES-R sensors.

The proposed algorithm for rainfall estimation includes two stages. The first stage involves in the feature selection and dimension compression of multi-spectral images using principal component analysis (PCA). The second stage involved in feature classification and rainfall estimation, in which a feature classification scheme, self-organizing feature map (SOM), and a probability matching technique is proposed to the fitting of the classified feature index to the rainfall rates. The study is conducted over an equatorial region west of Africa. Ten SEVIRI-spectral bands and textural features were extracted and tested for rainfall estimation. The concurrent image of MSG SEVIRI image and passive microwave (PMW) rainfall estimates from several low-orbital satellites were used for the model calibration and validation. The results show that more spectral channels improve both rain detection and estimation. By comparing the scenario using 10 SEVIRI bands with the one only using single thermal channel, the overall statistics, in terms of CORR, ETS, and POD skills, were increased about 17%, 50%, and 27%, and statistics for RMSE and FAR improved about 10% and 38 % respectively. Detail of modeling and evaluation will be discussed in the presentation.

23. *Transition of Satellite-based Nowcasting Capability into the GOES-R Era*

Presenter: Brian Vant-Hull, CREST at CCNY
Authors: Brian Vant-Hull, Shayesteh Mahani, Arnold Gruber, Reza Khanbilvardi, Robert Rabin, Robert Kuligowski, Mamoudou Ba, Bernhard Mhando, and Nasim Nourozi

A collaborative framework is being pursued by personnel at NOAA/NESDIS, the NOAA/NWS Meteorological Development Laboratory (MDL), the NOAA/OAR National Severe Storms Laboratory (NSSL), and the NOAA Cooperative Remote Sensing Science and Technology Center (CREST) at the City College of New York (CCNY) to develop a prototype satellite-based nowcasting capability for the New York City metropolitan area. This nowcasting capability would also serve as a test bed for implementing satellite based nowcasting capability throughout the United States as part of the System for Convection Analysis and Nowcasting (SCAN) which is a component of the NWS' Advanced Weather Information and Processing System (AWIPS).

Still in the exploratory phase of the project, the CREST nowcasting team has implemented the NESDIS satellite-based nowcasting algorithm Hydro-Nowcaster (HN) with rainfall retrieval algorithm, Hydro-Estimator (HE), and satellite-based Rapidly Developing Thunderstorm (RDT: Meteo-France) models to compare their ability to detect convective cells. We have also employed other collaborators to run the FORTRACC (Daniel Vila) and K-Means Correlation (Valiappa Lakshaman) models to compare their forecasting abilities. Preliminary results of these comparisons will be presented. Also included will be an outline of how the tracking algorithm of RDT may be used to improve precipitation estimates from IR imagery.

24.A. *Algorithm Intercomparison by the GOES-R AWG Hydrology Algorithm Team Part I: Rainfall Rates*

Author: Robert J. Kuligowski, NOAA / NESDIS / STAR

The GOES-R AWG Hydrology Algorithm Team (AT) is charged with developing and demonstrating operational algorithms for rainfall rate, 0-3 hour probability of rainfall, and 0-3 hour rainfall potential. As part of this process, the Hydrology AT evaluated six current real-time rainfall algorithms for potential implementation into the GOES-R Ground System: three variants of the Climate Prediction Center (CPC) MORPHing technique (CMORPH), the Naval Research Laboratory (NRL) algorithm, the Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) of the University of California at Irvine, and the Self-Calibrating Multivariate Precipitation Retrieval (SCaMPR) of NOAA/NESDIS . The AT provided test data sets to algorithm developers that used the METEOSAT-8 Spinning Enhanced Visible Infra-Red Interferometer (SEVIRI) as a proxy for most of the bands that will be available on the GOES-R Advanced Baseline Imager (ABI). Since all of these algorithms use microwave-based rainfall rates as a calibration data set, the developers were also provided with a unified microwave rain rate data set that is produced routinely by CPC. The developers used part of this data set to modify their algorithms to take advantage of the additional capabilities offered by the ABI, and the other part to produce an independent set of satellite rainfall estimates. These rainfall fields were evaluated against available rain gauge data in Europe, Africa, South America, and the Atlantic Ocean, and the results will be presented.

24.B. *Algorithm Intercomparison by the GOES-R AWG Hydrology Algorithm Team Part II: Cloud Nowcasting*

Author: Robert J. Kuligowski, NOAA / NESDIS / STAR

The GOES-R AWG Hydrology Algorithm Team (AT) is charged with developing and demonstrating operational algorithms for rainfall rate, 0-3 hour probability of rainfall, and 0-3 hour rainfall potential. As part of this process, the Hydrology AT evaluated six current real-time cloud nowcasting algorithms for potential implementation into the GOES-R Ground System: two variants of the NESDIS Hydro-

Nowcaster, three variants of the National Center for Atmospheric Research (NCAR) Thunderstorm Initiation, Tracking, and Nowcasting (TITAN) algorithm, and a K-Means technique developed at the NOAA National Severe Storms Laboratory (NSSL). The AT provided test data sets to algorithm developers that used the METEOSAT-8 Spinning Enhanced Visible Infra-Red Interferometer (SEVIRI) as a proxy for most of the bands that will be available on the GOES-R Advanced Baseline Imager (ABI). The developers used part of this data set to modify their algorithms to take advantage of the additional capabilities offered by the ABI, and the other part to produce an independent set of nowcast fields of visible, water vapor band, and IR window band field for lead times out to 3 hours at 15-minute intervals. These nowcasts were evaluated against corresponding SEVIRI data, and the results will be presented.

25. *An inter-comparison of five high resolution merged satellite precipitation estimates with three-hourly gauge data*

Presenter: Mathew R P Sapiano, University of Maryland
Authors: Mathew R P Sapiano; Philip A Arkin

The last several years have seen the development of a number of new satellite derived, globally complete, high resolution precipitation products with a spatial resolution of at least 0.25˚ and a temporal resolution of at least three-hourly. These products generally merge geostationary infrared data and polar-orbiting passive microwave data to take advantage of the frequent sampling of the infrared and the superior quality of the microwave. The Project to Evaluate High Resolution Precipitation Products (PEHRPP) was established to evaluate and inter-compare these datasets at a variety of spatial and temporal resolutions with the intent of guiding dataset developers and informing the user community regarding the error characteristics of the products. As part of this project, we have performed a sub-daily inter-comparison of five high-resolution datasets (commonly known as CMORPH, TMPA, NRL-Blended, the Hydro-Estimator and PERSIANN) with existing sub-daily gauge data over the US and the Pacific Ocean. Results show that these data are effective at representing high resolution precipitation, with correlations against three-hourly gauge data as high 0.7 for CMORPH, which had the highest correlations with the validation data. Biases are relatively high for most of the datasets over land (apart from the TMPA which is gauge adjusted) and ocean with a general tendency to overestimate warm season rainfall over the US and to underestimate rainfall over the Tropical Pacific Ocean. Additionally, all the products studied faithfully resolve the diurnal cycle of precipitation when compared with the validation data.

26. *Transitioning Nowcasting into the GOES-R Era: Progress in the New York City Metropolitan Area*

Presenter: Brian Vant-Hull, NOAA-CREST
Authors: Brian Vant-Hull, Robert Rabin, Mamoudou Ba, Shayesteh Mahani, Arnold Gruber, Robert Kuligowski, Stephan Smith

A collaborative framework is being pursued by personnel at NOAA/NESDIS, the NOAA/NWS Meteorological Development Laboratory (MDL), the NOAA/OAR National Severe Storms Laboratory (NSSL), and the NOAA Cooperative Remote Sensing Science and Technology Center (CREST) at the City College of New York (CCNY) to develop a prototype satellite-based nowcasting capability for the New York City metropolitan area. This nowcasting capability would also serve as a test bed for implementing satellite based nowcasting capability throughout the United States as part of the System for Convection Analysis and Nowcasting (SCAN) which is a component of the NWS' Advanced Weather Information and Processing System (AWIPS).

Still in the exploratory phase of the project, the CREST nowcasting team has implemented the NESDIS satellite-based nowcasting algorithm Hydro-Nowcaster (HN) with rainfall retrieval algorithm, Hydro-Estimator (HE), and Rapidly Developing Thunderstorm (RDT: Meteo-France) models to compare their ability to detect convective cells. We have also employed other collaborators to run the FORTRACC (Daniel Vila) and K-Means Correlation (Valiappa Lakshaman) models to compare their forecasting abilities. Preliminary results of these comparisons will be presented. Also included will be an outline of how the tracking algorithm of RDT may be used to improved precipitation estimates from IR imagery.

27. *GOES-R Nowcasting Algorithms: GOES-R Nowcasting Algorithms: A Ground Validation Approach using SEVIRI Data*

Presenter: Daniel Vila, ESSIC
Authors: Daniel Vila and Bob Kuligowski

One of the objectives of the Algorithm Intercomparison Test Plan is to objectively intercompare the performance of different algorithms under consideration by GOES-R Algorithm Working Group (AWG) Hydrologic Algorithm Team (AT) for the implementation on the Advanced Baseline Imager (ABI) onboard GOES-R.
This study shows the performance of a particular nowcasting technique (ForTrACC, Vila et al, 2008) during 6-9 January 2005 using SEVIRI thermal IR channel (10.8m) for several validation regions selected by the Hydrologic Algorithm Team (AT). In this case, following the guidelines of AWG, the forecast is performed every 3 hours beginning at 00:00Z and cover every 15 minutes out to a lead time of 3 hours.

The statistics are performed based on contingency tables for a given region. This methodology shows the frequency of 'yes' and 'no' forecast and observations (pixels whose brightness temperature are below certain threshold) and several statistical parameters are performed using this information like Probability of Detection (POD), False Alarm Ratio (FAR), among others.

28. *The UW/CIMSS High Spectral Rosulotion IR Land Surface Emissivty Database*

Presenter: Eva E Borbas, CIMSS/SSEC/UW-Madison
Authors: Borbas, E. E., S. W. Seemann, R. O. Knuteson, E. Weisz, and A. Huang

A global infrared land surface emissivity database with high spectral and high spatial resolution is introduced. The database is derived from a combination of high spectral resolution laboratory measurements of selected materials, and the UW/CIMSS Baseline Fit (BF) Global Infrared land Surface Emissivity Database (Seemann et al., 2007) by using principal component analysis (PCA) regression. The goal of this work is to create a spectrum of emissivity from 3.6 to 14.3 µm for a given month, for every latitude/longitude point globally at 0.05-degree spatial resolution at 416 wavenumbers. To create a high spectra resolution emissivity dataset the PCs (eigenvectors) of laboratory spectra are regressed against the UW/CIMSS BF emissivity data. The characteristics of the input data, the methodology, how many PCs to use and some tests on laboratory measurements, the SeeBor clear sky training profile database are shown. The effect of the IR emissivity on AIRS clear sky single FOV retrievals is also presented. At the end as part of our validation study, comparison with the UW AIRS emissivity retrievals and a case study over a desert location is shown.

29. *Daily NDVI and Brightness Temperature Composite methods for GOES-R Vegetation Health Index Products: Ecosystem Studies*

Presenter: Yuhong Tian, IMSG at NOAA
Authors: Yuhong Tian, Wei Guo, Felix Kogan, Hui Xu, Peter Romanov, Dan Tarpley, and Yunyue Yu

Vegetation Health Index (VHI), which is estimated from a combination of long-term record of normalized difference vegetation index (NDVI) and brightness temperature (BT), is an useful parameter being applied for monitoring land surface conditions. For instances, VHI is applied for detecting early drought and monitoring land degradation, agricultural production, deforestation and desertification, land cover/land changes and climate change. In developing GOES-R algorithms of land surface products, we designed a prototype VHI algorithm using a proxy dataset from the SEVIRI sensor onboard the European Meteosat Second Generation (MSG) geostationary satellite. In this study, one year of SEVIRI data recorded at half-hour interval was collected and used, and 102 study stations were chosen from a variety of vegetation types and geolocations. Different criteria of estimating VHI were set to find the best method for obtaining the best quality and highest values of NDVI and BT on daily base. We found that (1) NDVI and BT values from half-hour composites are higher than those from one-hour composites; (2) NDVI and BT values from all-day composites are higher than those from afternoon-only composites; (3) NDVI values from maximum NDVI composites are higher than those from maximum BT composites; (4) BT values from maximum NDVI composites are lower than those from maximum BT composites; (5) for all-day composites, the local time at the maximum NDVI is earlier than that at the maximum BT.

30.A. *GOES-R Land Algorithm Working Group Team: Activities and Accomplishments*

Presenter: Yunyue Yu, NOAA/NESDIS/STAR
Authors: Yunyue Yu, Kevin Gallo, Felix Kogan, Dan Tarpley, Christopher Schmidt, Elaine Prins, Peter Romanov, Konstantin Vinnikov, Hui Xu, Wei Guou, Yuhong Tian, M. K. RamaVarma Raja

The US National Oceanic and Atmospheric Administration (NOAA) is developing a new generation Geostationary Operational Environmental Satellite (GOES) R series (GOES-R), which comprises improved spacecraft and instrument technologies, for providing more timely and accurate products for environmental monitoring and weather forecasting. The GOES-R Applications Working Group (AWG) land team is responsible for developing, evaluating and delivering corresponding algorithms for generating land surface products including land surface temperature (LST), surface albedo, normalized difference vegetation index (NDVI), green vegetation fraction (GVF), active fire, and standing water products. Currently, the AWG land team has finalized techniques needed for land surface temperature, vegetation index and the active fire products. Split window techniques will be applied for the LST algorithm development and the algorithm coefficients will be stratified for dry and moist atmospheric conditions as well as for daytime and nighttime. In the NDVI algorithm development, daily composite NDVI will be obtained from half hourly NDVI using maximum NDVI compositing technique, while weekly composite NDVI will be obtained from the maximum daily NDVI. The ABI fire algorithm builds on the heritage Wildfire Automated Biomass Burning Algorithm (WF_ABBA) which is already operational on the current GOES. Currently, algorithms for LST, NDVI and fires are being tested using MSG/SERIVI, MODIS simulated ABI data, and model simulated data. The results are promising. The algorithm critical design review for the above products has been conducted. This presentation will show details of these activities and achievements.

30.B. *GOES-R Algorithm Development for Land Surface Temperature: Algorithm Verification*

Presenter: Yunyue Yu, NOAA/NESDIS/STAR
Authors: Yunyue Yu, Dan Tarpley, Konstantin Vinnikov, Hui Xu, M. K. RamaVarma Raja

Algorithm verification is one of the core steps in developing the land surface temperature (LST) product for the GOES-R mission. It is also one of the most difficult tasks in the LST algorithm development phase, because of significant spatial and temporal variability of land surface emission. A large number of coincident satellite and ground LST observations (i.e., match-up dataset) are needed for evaluating the LST algorithm. As part of the evaluation component of the LST algorithm development for the GOES-R Advanced Baseline Imager (ABI), we produced the match-up dataset using the SURFace RADiation (SURFRAD) network ground measurements and the GOES-8 and -10 satellite observations. The dataset covers one-year of GOES Imager data over SURFRAD stations in the United States, representing unique geographic regions. A stringent cloud filtering procedure was applied to minimize the effect of cloud contamination before the match-up dataset being used for the LST evaluation. Over period of the year (2001), more than a thousand cloud filtered satellite-ground data pairs were collected at each of the SURFRAD sites. This high number of the match-up dataset ensured confidence in the statistical analyses related to the LST algorithm evaluation. The evaluation was performed by comparing the SURFRAD and satellite LST pairs for each site. The statistical comparison demonstrated that LST measurements from SURFRAD instrument can be used in our evaluation effort for GOES-R LST algorithm development, and noise of the SURFRAD data can be tolerated at certain level. In particular, precision of the GOES LST algorithm can be fairly well estimated. Also, we applied the GOES-R LST algorithm to data from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) of European Meteosat Second Generation (MSG) satellite for the software verification. The results are promising.

31. *Enhacing fire detection accuracy by accounting for solar reflection and atmospheric IR emission*

Presenter: Zhanqing Li, University of Maryland
Authors: Zhanqing Li, Liming He

Traditional fire detection algorithms with either fixed or contextual thresholds mainly rely on the temperature contrast between a fire pixel and its surrounding pixels in the Middle-Infrared (MIR) and Thermal-Infrared (TIR) bands. Our analysis indicates that the solar contamination and the thermal path radiance in the MIR band weakens the contextual contrast between the high and low temperature objects and significantly reduces the capability of detecting fires during daytime. The degree of solar contamination in the MIR band depends on variable surface albedo, solar zenith angle and atmospheric conditions. A methodology is proposed to eliminate the solar radiation and thermal path radiance received by any MIR band including that of the GOES-R. The modified MIR brightness temperature (BT) is incorporated into the existing fire detection algorithm after re-tuning the daytime thresholds. Both commission errors and omission errors were reduced. Forty-five percent more real fire pixels are detected while the commission error was lowered by 2%. Reduction of the commission error is most significant for areas that are problematic in fire detection, i.e. low biomass areas and urban areas, while the omission error is diminished more for high biomass areas.

32. *Development Of Snow Mapping Algorithm For GOES-R*

Presenter: Peter Romanov, CICS, University of Maryland
Authors: Peter Romanov, Cezar Kongoli

Enhanced observing capabilities of the Advanced Baseline Imager (ABI) onboard GOES-R as compared to the previous generation GOES Imager, will allow for improved retrievals of atmosphere, land surface and ocean properties and in particular, improved mapping of snow cover. Expected improvements in the snow mapping with GOES-R are primarily due to ABI additional spectral channels centered in the near-infrared, short-wave infrared and split-window infrared bands. A higher rate of observations provided by ABI and better image registration may also be beneficial for the snow cover monitoring.

This poster presents the results of the work on the development of an operational algorithm for snow mapping with GOES-R ABI. Snow identification technique is based on observations in the visible, near-infrared, shortwave-infrared and thermal infrared spectral bands. Besides spectral criteria, the algorithm utilizes information on temporal variation of the scene temperature and reflectance in order to improve discrimination between snow and clouds in the satellite imagery. A number of additional tests involving the land surface temperature climatology and the snow cover climatology are employed to further reduce the number of image classification errors.

In this work Meteosat Second Generation (MSG) SEVIRI is used as GOES-R ABI prototype. With MSG data we routinely generate daily snow cover maps over Europe and North Africa. The hourly snow cover product is being developed. The results of the automated snow mapping are compared to and validated against NOAA interactive snow cover charts generated with the Interactive Multisensor Snow and Ice System (IMS) and against surface observations of snow cover.

33. *Development of an advanced technique for mapping and monitoring sea ice for the future GOES-R Advanced Baseline Imager (ABI)*

Presenter: Marouane Temimi, NOAA-CREST/City College/CUNY
Authors: Marouane Temimi, Hosni Ghedira, Reza Khanbilvardi and Peter Romanov

Information on ice cover extent over seas is crucial for ship navigation. Ice cover can also show interannual fluctuations and reflects climate variations. Ability of satellites to provide global observations at high temporal frequency has made them the primary tool for the ice cover monitoring. This study is a part of GOES-R Cryosphere application group effort to develop new, and improve existing, applications for the future GOES-R Advanced Baseline Imager (ABI).

In this paper, a new approach was developed to minimize the effect of both observation and illumination angles on the ice mapping accuracy. A Bidirectional Reflectance Distribution Function (BRDF) was developed to simulate ice and water reflectances over the Caspian Sea. In order to develop BRDF models we have collected a large dataset of MSG SEVIRI observations over water and over ice. Satellite images over Caspian Sea acquired during the winter season of 2006-2007 were examined visually and cloud clear pixels were identified.

The ultimate objective of this research is to develop a daily ice extent and concentration maps. The estimation of water and ice reflectances is a step toward the achievement of this goal. The Northern region of the Caspian Sea has been selected for algorithm development and calibration. Artificial Neural Networks (ANN) have been used to simulate reflectance values for both water and ice from sun-satellite geometry information. Data collected by SEVIRI instrument onboard of Meteosat Second Generation (MSG) satellite have been used as a prototype. The simulated reflectances were compared to observed values and have shown a satisfactory agreement.

A mixing model has been applied using the simulated ice and water reflectances to retrieve the sea ice concentration. The approach used in the algorithm development includes daily and weekly cloud-clear image compositing. In addition, daily NOAA IMS snow and ice charts for 2006-2007 and 2007-2008 winter seasons have been acquired to validate the obtained ice cover maps. IMS snow charts are originally prepared on a polar-stereo projection and have a nominal spatial resolution of 4 km. A procedure has been developed to reproject IMS snow/ice charts and convert them to the lat-lon projection same as of SEVIRI data. The ice cover identified in the SEVIRI image closely corresponds to the ice distribution mapped in the IMS snow and ice chart by the NOAA analyst.

34. *Validation and Application of the GOES-R Vegetation Index Algorithm*

Presenter: Hui Xu, IMSG Inc.
Authors: Hui Xu, Peter Romanov, Dan Tarpley, Kevin Gallo, and YunYue Yu

The GOES-R ABI will be the first GOES imaging instrument providing observations in both the visible and the near infrared spectral bands and therefore can be used to generate vegetation index for monitoring the state of the vegetation cover as well as identifying a vegetation stress and drought. In addition to its improved spectral capability, the advantage of GOES-R ABI can be demonstrated through enhanced spatial (c. 1 km for visible and near infrared channels) and temporal (every 5 min.) resolutions.

This poster presents part of the GOES-R AWG land team work on generating instantaneous normalized difference vegetation index (NDVI) products and evaluating compositing algorithms for NDVI using Meteosat 8/9 SEVIRI data as a proxy for GOES-R ABI. Collection of a set of SEVIRI full-disk 2-byte images started in late February 2007 to test the GOES-R NDVI algorithm and assess potential applications.

Examples of NDVI products derived from MSG SEVIRI data are presented. Diurnal variations of the derived NDVI are evaluated for different land cover types and for different seasons. The seasonal changes of daily and weekly NDVI composite values over different locations with different vegetation types are also examined. The impacts of solar and sensor view angles as well as vegetation phenology are assessed through the seasonal analysis. In addition, NDVI retrievals from the geostationary satellite are compared with data from NOAA AVHRR, demonstrating the advantage of the enhanced spectral and spatial resolutions of the new generation geostationary satellites for vegetation monitoring.

35. *GOES-R Vegetation Health Index: Activities and Accomplishments*

Presenter: Wei Guo, IMSG at NESDIS/STAR
Authors: Wei Guo, Felix Kogan, Yunyue Yu, Peter Romanov, Le Jiang, Dan Tarpley, Yuhong Tian

Vegetation health product derived from NOAA polar-orbiting meteorological satellites was proven to be very useful to monitoring global vegetation condition change. The Advanced Baseline Imager (ABI) onboard Geostationary Operational Environmental Satellite (GOES) R series (GOES-R) will have the similar visible bands as the Advanced Very High Resolution Radiometer (AVHRR) of the NOAA satellites, which makes it possible to produce improved vegetation health product using high frequent observations. We used the data from Spinning Enhanced Visible & InfraRed Imager (SEVIRI) onboard the Meteosat Second Generation (MSG) satellites as proxy data set for designing and developing the GOES-R/ABI vegetation health product prototype system. Three years MSG/SEVIRI full disk images (11 bands, 15 minutes interval) were collected for building up climatology of the vegetation health index (VHI). We then investigate relationships between the VHI derived from the SEVIR data and from the AVHRR data. An interactive analyzing and visualization tool has been developed, which is beneficial to researchers to analyze the SEVIRI (or ABI) data. For detecting cloud contamination of the SEVIRI data, cloud mask files were generated for each day-time SEVIRI image using a simple cloud detection technique. Statistics of the cloud percentage on daily product and N-day composite product were performed for selected periods and ecosystems, which provide key parameters in determining final prototype of the VHI product.

36. ***Land surface characteristics information and in situ data for GOES-R land surface product validation.***

Presenter: Kevin Gallo, NOAA/NESDIS/STAR
Authors: Kevin Gallo, NOAA/STAR and Robert Hale, CIRA/CSU

Several satellite (e.g., MODIS, ASTER, and LANDSAT) and in situ (e.g., SURFRAD and CRN) data sets exist for use in validation of GOES-R land data products. These data sets will be reviewed along with examples of results of analysis of land cover, land surface temperature (LST) and emissivity variation at several spatial scales of GOES ABI pixels for several potential validation test sites. Additionally, a comparison of LST data from several designated pairs of Climate Reference Network (CRN) stations will be presented.

37. ***GOES-R ABI Smoke/Dust Detection Product***

Presenter: Pubu Ciren, PSGS &NOAA/NESDIS
Authors: Shobha Kondragunta, Pubu Ciren, Xuepeng(Tom) Zhao, Steve Ackerman and Rich Frey

Appearing of smoke/dust largely degrades the quality of air that human being is breathing, therefore, directly affects the public health. As one of the components in GOES-R AAA (Aerosol, Air Quality and Air Chemistry) AWG, detection of smoke/dust over the GOES-R ABI observation domain in a timely and qualitatively accurate manner over pixel-level is an important product. To this end, a threshold-based, therefore, efficient and MODIS heritage algorithm is adopted.

The adopted algorithm is based on the fact that smoke/dust exhibits features of spectral dependence and contrast over both visible and Infrared spectrum that are different from clouds and clear-sky atmosphere. The core of the detection algorithm lies on threshold tests which separate smoke/dust from cloud and clear-sky over ocean and land, respectively.

By using MODIS observation as proxy, GOES-R ABI smoke/dust algorithm has bee tested on various scenarios, such as biomass burning, wild fires, dust storm, and dust transport from Africa continent. Comparisons with RGB image and other satellite products have been performed along with the sensitivity study of the detection on the accuracy of sensor radiances/brightness temperature.
In this paper, we present (1) the development of smoke/dust detection algorithm for future GOES-R ABI; (2) flowchart of smoke/dust detection algorithm; (3) GOES-R ABI channel input and table contains threshold for various tests; (4) smoke detection over land and ocean; (5) dust detection over land and ocean; (6) some examples of comparison and evaluation; and (7) conclusions and future improvements.

38. ***A Near-Real-Time Global Geostationary Satellite Cloud and Radiation Retrieval System***

Presenter: Patrick Minnis, NASA-LARC
Authors: P. Minnis, L. Nguyen, W. L. Smith, R. Palikonda, D. Spangenberg, M. Khaiyer, C. Yost, T. Chee, K. Ayers, F. Chang, P. Heck

Cloud property retrievals from passive satellite measurements have been vital to understanding cloud processes and for characterizing clouds and their roles in climate. With the increased use of high-resolution numerical weather prediction models and the need for more quantitative weather information for forecasting and nowcasting, timely delivery of cloud and radiation information is becoming imperative. This paper describes the development of a prototype system to provide first 3-hourly, then higher resolution retrievals of cloud properties from full-disk geostationary satellites (GEOSat) around the globe. The GEOSat data,from GOES-11/12, Meteosat-9, MTSAT, and FY-2C, are all calibrated to MODIS radiances and analyzed with the same algorithms to produce a consistent set of retrievals. The derived products include a cloud mask (fractional coverage), cloud phase, cloud base and top heights and pressures, optical depth, ice and liquid water paths, effective particle sizes, and overlap (for particular satellites), an aircraft icing index, surface skin temperature, shortwave and visible albedos, outgoing longwave radiation, and surface radiative fluxes. Analyses of Aqua and Terra MODIS data are being used to provide data in polar regions. Active and passive remote sensing data from the surface and other satellites are being used to validate the products. Examples are presented and future plans are discussed.

39. ***Application of satellite aerosol measurements to air quality monitoring and forecasting***

Presenter: Hai Zhang, UMBC
Authors: Hai Zhang, Raymond M. Hoff, Shobha Kondragunta

Infusing satellite Data into Environmental Applications (IDEA) was created through a NASA/EPA/NOAA cooperative effort and involves the near-real time dissemination of aerosol optical depth data from MODIS to the public using the UW direct broadcast capture of MODIS data. The product has been transferred and enhanced from UW to NESDIS for a preoperational test. In addition to the MODIS AOD data from Terra, the MODIS AOD from Aqua and GOES Aerosol and Smoke Product (GASP) are included in the enhanced product so that it provides twice per day update from MODIS and 30-minute intervals update (day time) from GASP. Air quality forecast guidance is produced through a trajectory model initiated at locations with high AOD retrievals with twice per day from MODIS and three times per day from GASP. The IDEA beta test site is located at http://www.star.nesdis.noaa.gov/smcd/spb/aq/, and comments are welcome. It is prepared to use GOES-R aerosol product from the ABI, which will have nearly the same capabilities as MODIS to generate multi-wavelength retrievals of AOD with high temporal and spatial resolutions. The product will be run at NESDIS and will be a NOAA supported product relevant to air quality decisionmakers.

40. *Studying the Near-Earth Space Radiation Using GOES-R*

Presenter: Paul T.M. Loto'aniu, NOAA/SWPC - CU/CIRES
Authors: Paul T.M. Loto'aniu, H.J. Singer, T. Onsager and J. Cannon

The near-Earth space radiation environment includes energetic ions and elections that cause spacecraft charging, single event upsets (SEUs), degrade electronic components and increase cancer risks to humans in space. Since their inception in the 1970's, the GOES satellites have monitored Earth's highly variable radiation environment using particle detectors and magnetometers. These measurements are important for providing alerts and warnings to many customers, including satellite operators, the power utilities, and NASA's human activities in space. The GOES-R magnetometer requirements are similar to those previously flown and measures three components of the geomagnetic field with a resolution of least 0.016 nT, but with higher sampling than previous GOES at 8 Hz. The particle detectors (SEISS) will expand energies covered by previous GOES with electrons from 30 eV to 4 MeV and ions from 30 eV to over 500 MeV. GOES-R will also distinguish 4 heavy ion species. The GOES-R SEISS and magnetometer products will be an integral part of the NOAA space weather operations. These data products will also be important for scientific research into the causes of enhancements of Earth's radiation belts. Here, an overview is given of some of the ways in which the magnetometer and SEISS data can be used to better understand the near-Earth space radiation environment.

41. *GOES-R Algorithm Working Group: Space Weather Team Update*

Presenter: Steven Hill, Space Weather Prediction Center
Authors: S. Hill, H. Singer, T. Onsager, R. Viereck, D. Biesecker, C. Balch, M. Shouldis, P. Loto'aniu, J. Gannon, L. Mayer, J. Rigler, D. Wilkinson

The Space Weather (SWx) Application Team (AT) of the Algorithm Working Group (AWG) addresses algorithm development and readiness for the Solar Ultraviolet Imager (SUVI), Extreme Ultraviolet and X-ray Irradiance Suite (EXIS), Space Environment In Situ Suite (SEISS), and magnetometer. Membership draws on NOAA's Space Weather Program and includes representation from the NCEP Space Environment Center (SEC) and from the NESDIS National Geophysical Data Center (NGDC). Significant progress has been made in the first phase of algorithm development. In the past year, the SWx AT has inventoried existing algorithms, held an algorithm design review, created algorithm flowcharts, developed proxy data, and created a product validation approach, and deployed a shared development environment. This poster presents highlights of the past year's progress and provides example product maps from data source to product to customer.

42. *Extending Dynamic Range in Solar UV Images with Optimized Composites*

Presenter: E. J. Rigler, CIRES/SWPC
Authors: E. J. Rigler and S. M. Hill

The GOES-R Solar Ultraviolet Imager (SUVI) will generate full-disk images of the sun at wavelengths of great interest to space weather forecasters. However, the single-scene dynamic range of solar irradiance at these wavelengths is potentially much greater than even the advanced optics and electronics employed by the SUVI instrument are capable of capturing. One solution is to optimally combine multiple, nearly simultaneous, images of the sun that differ only in their exposure times, thus reducing or eliminating image artifacts related to both low-count instrument noise and CCD pixel saturation. These composite images will then serve as the primary input to nearly every other planned level 2+ SUVI product.